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Manufacturing with RDRAM* Memory Technology Part II

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Agenda - Part II

- Manufacturing Considerations
  - Motherboard Integration
  - System Level Integration
- Impedance Considerations
- Manufacturing Debug Message
  - Methodology to Debug Failures

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Manufacturing with RDRAM Memory Technology

- Manufacturing Considerations
  - Motherboard Integration
  - System Level Integration

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Manufacturing with RDRAM Memory Technology: Motherboard Integrating

- **Thermal Solutions:**
- Both the Intel® 820 and Intel® 840 Chipsets have Thermal Reference documents.
  - These documents detail considerations for managing component, motherboard, and system thermals. Please contact your local sales representative to request a copy of these documents.
- Thermal Solutions - Customers need to validate their thermal solutions in their application.

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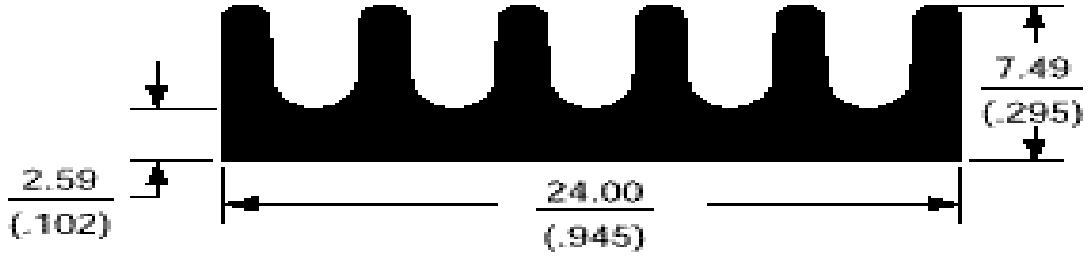
Intel® 820 Chipset MTH- (241 BGA - 23 x 23 mm) Thermal Solution

No Heat Sink Attached	Tcase spec °C =	113					
Amb °C	No Heatsink Tcase(C) table at TDP						
60	121	117	115	112	111	110	109
55	116	112	110	107	106	105	104
50	111	107	105	102	101	100	99
45	106	102	100	97	96	95	94
40	101	97	95	92	91	90	89
35	96	92	90	87	86	85	84
LFM ->	0	50	100	150	200	250	300

Heat Sink Attached	Tcase spec °C =	97					
Amb °C	Heatsink Tcase(C) table at TDP						
60	97	93	90	88	86	84	83
55	92	88	85	83	81	79	78
50	87	83	80	78	76	74	73
45	82	78	75	73	71	69	68
40	77	73	70	68	66	64	63
35	72	68	65	63	61	59	58
LFM ->	0	50	100	150	200	250	300

Notes:
1) The **unshaded** values are airflow/ambient combinations which will exceed the allowable case temperature for MTH, the **shaded** values do not exceed allowable case temperatures.
2) Heat Sink case assumes the default thermal solution.
3) Tcase max with no heat sink is 113C, Tcase max with a heat sink is 97C.
4) All data is preliminary and is not validated against physical samples.
5) Zero Airflow is defined as a natural convection environment.



Extruded Heatsink Drawing for the MTH

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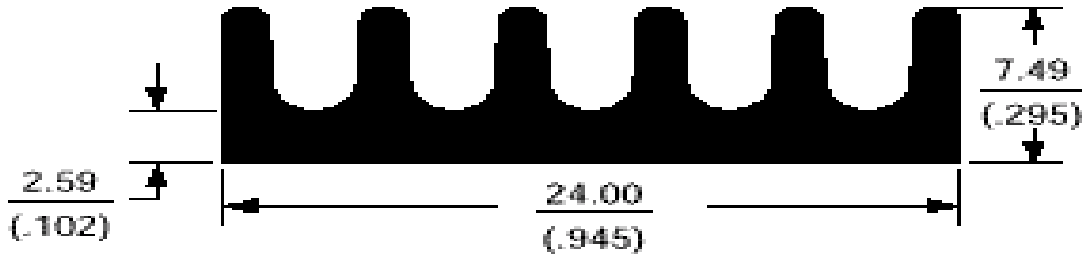
Intel® 840 Chipset MRH-S - (241 BGA - 23 x 23 mm) Thermal Solution

No Heat Sink Attached	Tcase spec °C =	113					
Amb °C	No Heatsink Tcase(C) table at TDP						
60	131	126	123	121	119	117	116
55	126	121	118	116	114	**112**	**111**
50	121	116	**113**	**111**	**109**	**107**	**106**
45	116	**111**	**108**	**106**	**104**	**102**	**101**
40	**111**	**106**	**103**	**101**	**99**	**97**	**96**
35	**106**	**101**	**98**	**96**	**94**	**92**	**91**
LFM ->	0	50	100	150	200	250	300

Heat Sink Attached	Tcase spec °C =	97					
Amb °C	Heatsink Tcase(C) table at TDP						
60	105	101	97	**95**	**93**	**92**	**91**
55	100	**96**	**92**	**90**	**88**	**87**	**86**
50	**95**	**91**	**87**	**85**	**83**	**82**	**81**
45	**90**	**86**	**82**	**80**	**78**	**77**	**76**
40	**85**	**81**	**77**	**75**	**73**	**72**	**71**
35	**80**	**76**	**72**	**70**	**68**	**67**	**66**
LFM ->	0	50	100	150	200	250	300

Notes:
1) The **unshaded** values are airflow/ambient combinations which will exceed the allowable case temperature for MRH-S, the **shaded** values do not exceed allowable case temperatures.
2) Heat Sink case assumes the default thermal solution.
3) Tcase max with no heat sink is 113C, Tcase max with a heat sink is 97C.
4) All data is preliminary and is not validated against physical samples.
5) Zero Airflow is defined as a natural convection environment.



Extruded Heatsink Drawing for the MRH-S

Intel® 820 Chipset MTH & Intel® 840 Chipset MRH-S 23 x 23 mm Thermal Solution

Motherboard Clearances

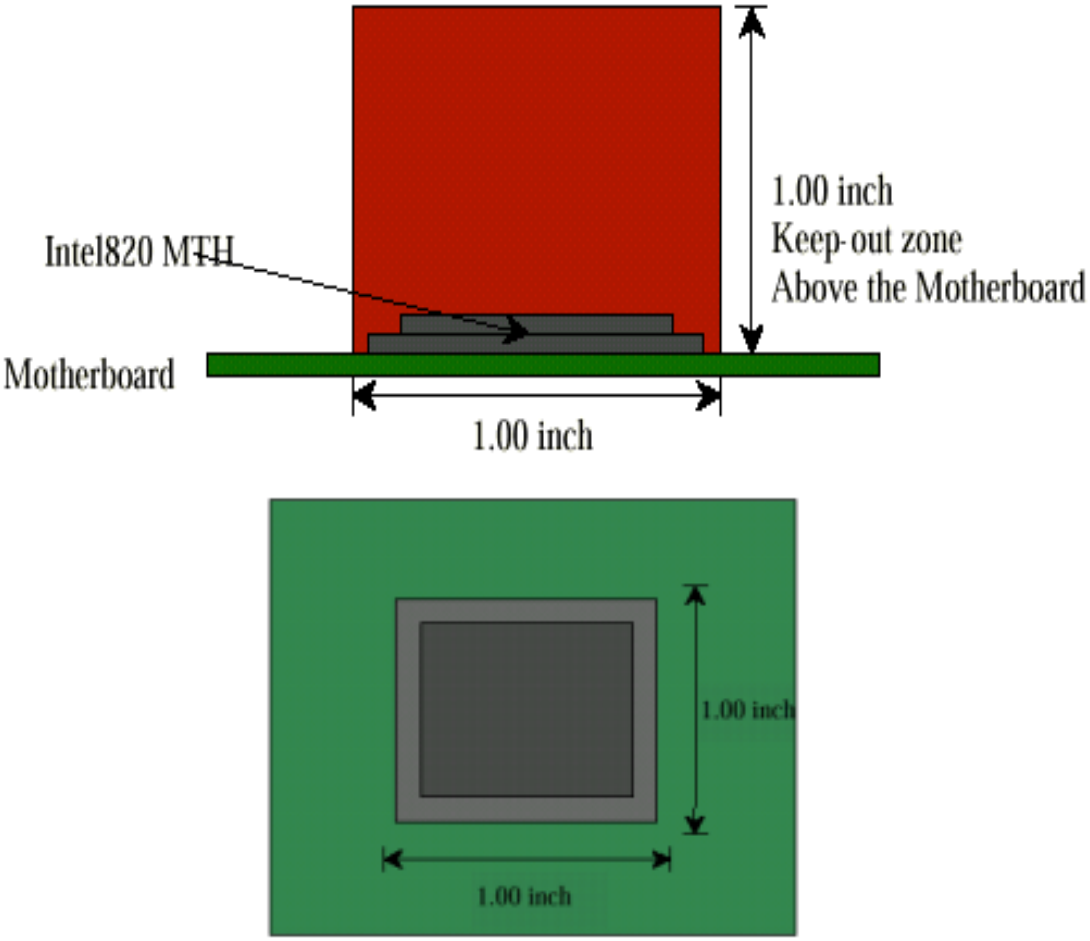


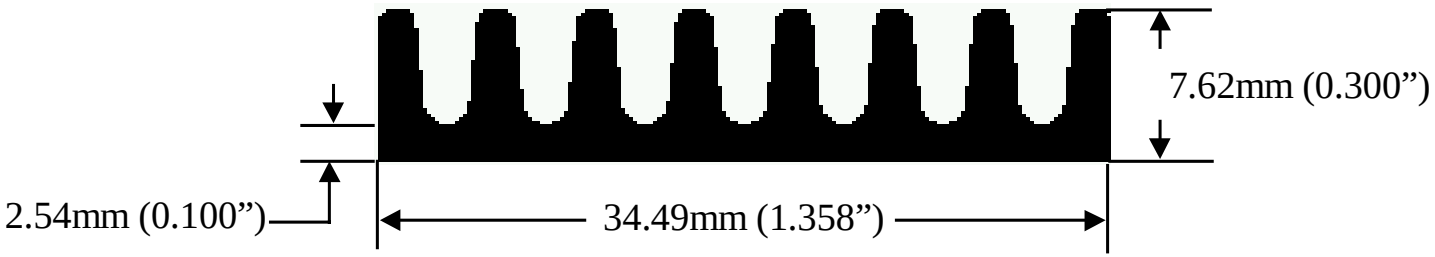
Figure 6-8. Heat Sink volume restrictions for the MTH when attached to the Motherboard.

Intel® 840 Chipset MCH - (544 BGA 35 x 35 mm) Thermal Solution

No Heat Sink Attached	Tcase spec °C =	110					
Amb °C	No Heatsink Tcase(C) table at TDP						
60	121	117	113	111	**109**	**108**	**106**
55	116	112	**108**	**106**	**104**	**103**	**101**
50	111	**107**	**103**	**101**	**99**	**98**	**96**
45	**106**	**102**	**98**	**96**	**94**	**93**	**91**
40	**101**	**97**	**93**	**91**	**89**	**88**	**86**
35	**96**	**92**	**88**	**86**	**84**	**83**	**81**
LFM ->	0	50	100	150	200	250	300

Heat Sink Attached	Tcase spec °C =	97					
Amb °C	Heatsink Tcase(C) table at TDP						
60	103	98	**95**	**93**	**91**	**89**	**87**
55	98	**93**	**90**	**88**	**86**	**84**	**82**
50	**93**	**88**	**85**	**83**	**81**	**79**	**77**
45	**88**	**83**	**80**	**78**	**76**	**74**	**72**
40	**83**	**78**	**75**	**73**	**71**	**69**	**67**
35	**78**	**73**	**70**	**68**	**66**	**64**	**62**
LFM ->	0	50	100	150	200	250	300

Notes:
1) The **unshaded** values indicate airflow/ambient combinations which will exceed the allowable case temperature for MCH, the shaded values do not.
2) Heat Sink case assumes the default thermal solution.
3) Tcase max with no heat sink is 110C, Tcase max with a heat sink is 97C.
4) All data is preliminary and is not validated against physical samples.
5) Zero Airflow is defined as a natural convection environment.



Extruded Heatsink Drawing for the MCH

Intel® 840 Chipset MCH - 35 x 35 mm Thermal Solution

Motherboard Clearances

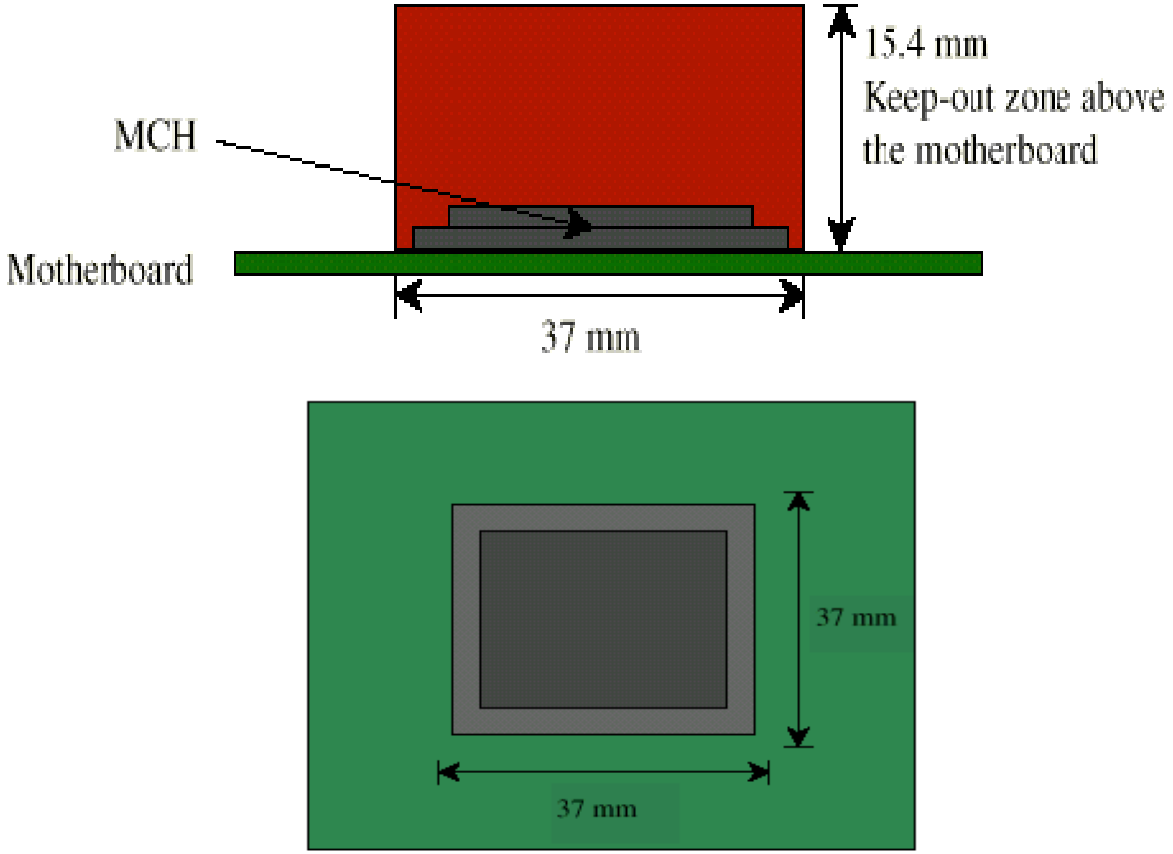


Figure 6-11. Heat Sink volume restrictions for the MCH.

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Heatsink Attach Options

- **Clips:** A well-designed clip in conjunction with a thermal interface material (tape, grease, etc.) solution may offer the best combination of mechanical stability and reworkability.
  - This requires significant advance planning as mounting holes may be required in the PCB.
- **Epoxy:** The epoxy option requires the user to plan the process carefully because once attached, the heatsink may be difficult or impossible to remove without damaging the component.
  - See Manufacturers recommendations for epoxy usage.
- **Tape:** For users who prefer tape, refer to vendor list included. To maximize the bond line contact area and improve adhesion, two pieces of tape are recommended, one attached to the heatsink and one attached to the moldcap on the chipset.

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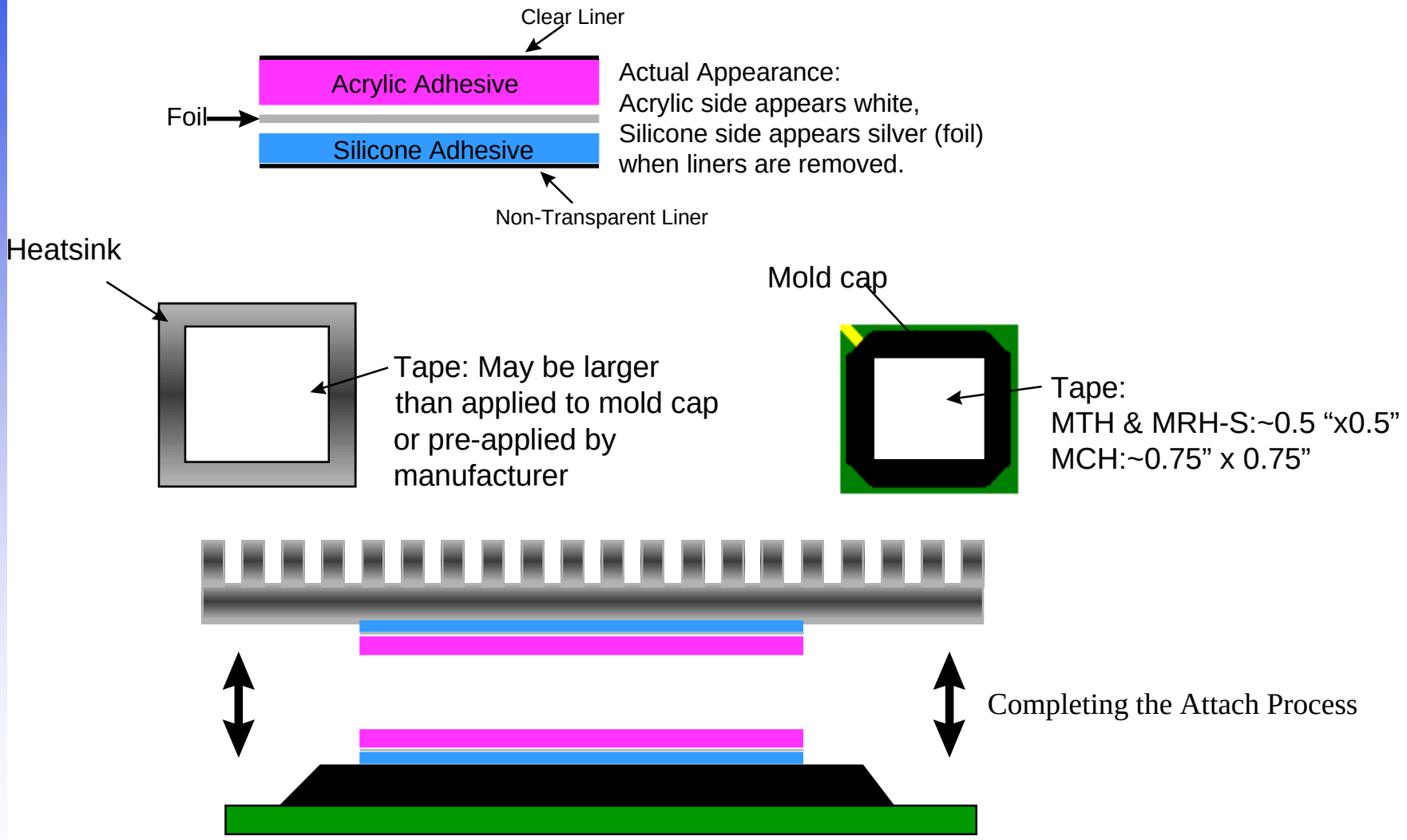
Tape Attach Option



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Tape Attach Option (cont'd)

- **Ensure that the surface of the component and heatsink are free from contamination.** Use a clean, lint-free wipe, proper safety precautions, and isopropyl alcohol to ensure cleanliness.
- Cut tape to size. Suggestions for the appropriate size can be seen in previous foil.
- Heatsink Side: Remove the non-transparent liner. You will see foil underneath. Apply the tape to the center of the heatsink and smooth over the entire surface using moderate pressure. **There should be no air bubbles under the tape.**
- Component Side: Remove the non-transparent liner. You will see foil underneath. Apply the tape to the center of the mold cap and smooth over the entire surface using moderate pressure. **There should be no air bubbles under the tape.**
- Both Sides: Remove the clear liners from each side, center the heatsink over the component and apply using any one of the manufacturer's recommended temperature/pressure options. **When applying pressure during attach, care should be taken to ensure that the motherboard is kept flat, bending or flexing the motherboard during application of the thermal solution may damage the solder joints of the Intel® chipset. Excessive bending/flexing will create open joints.**

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Manufacturing with RDRAM Memory Technology: Motherboard Integrating

- Rambus* Spec Level - The Rambus Spec level refers to electrical and mechanical specifications for the Rambus solution including connector, RIMM, CRIMM, DRCG, etc..
  - Rambus Specs Include:
    - 0.1 - Initial concept
    - 0.5 - Initial prototype
    - 0.9 - Pilot builds
    - 1.0 - Production Material
- Rambus Spec Level Mixing - All material used in production should be spec level 1.0 or greater.

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Manufacturing with RDRAM Memory Technology: System Integrating

- Mixing RIMM* and Continuity RIMM* Modules
  - Different motherboards will different rules for optimization. The motherboard technical specifications should be consulted.
- Mixing RIMM module sizes and types
  - Motherboard technical specification should be consulted to identify which speed, and type (ECC, non-ECC), of RIMM* module is supported.
  - RIMMmodules can be of different size. However, dual RDRAM Channel configurations may require both Channels to be populated identically.
  - Some motherboards will default to the slowest RIMM module speed installed.
  - When ECC RIMM modules are installed, some motherboards allow you to enable/disable ECC. Installing non-ECC RIMMs, or mixing ECC and non-ECC RIMM modules may result in ECC being disabled.

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Manufacturing with RDRAM Memory Technology: System Integration

- **RIMM Module/Continuity RIMM Module Insertion - Key Messages**
  - RIMM modules require more insertion force than do DIMM modules
  - Continuity RIMM Module insertion force is more than with DIMM but less than RIMM* module
  - RIMM and Continuity RIMM Modules are keyed or polarized to ensure correct RIMM*/CRIMM* to socket alignment.
  - To avoid connector damage, special care should be given to align the module straight and in the connector before applying insertion force.
  - When integrating systems in high volume, a RIMM module insertion tool can be used to ease ergonomic stress from repeated RIMM module insertions.
- **Motherboard Integration**
  - Recommendation is to insert RIMMs and CRIMMs* in the motherboard before anchored to the chassis. Utilize a flat surface for integration of the RIMM/CRIMM
    - Possible damage can result to the motherboard due to flex if installed once in the chassis.

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Manufacturing with RDRAM Memory Technology:

RIMM Module Insertion Tool

- In high-volume manufacturing, repeated RIMM module insertions can result in ergonomic stress. A RIMM/DIMM insertion tool can be used to more ergonomically apply the necessary insertion force.

Example of a RIMM module Insertion Tool

Vendor Part Number: 749217-001

Vendor: Dexter Design and Development Co. (503) 648-7000

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Manufacturing with RDRAM Memory Technology

Independent of connector type, there is a higher insertion force for RIMM modules when compared to DIMMs.

Summary:

- Insertion force is dependent on connector type and module thickness.
- Insertion force increases with module thickness
- Insertion force varies with different RIMM module connector vendors.
- For the initial RIMM Module Insertion, the insertion force can be up to 33% greater for RIMM modules compared to DIMMs.
- For subsequent RIMM Module insertions, the insertion force can be up to 25% greater for RIMM module compared to DIMMs.

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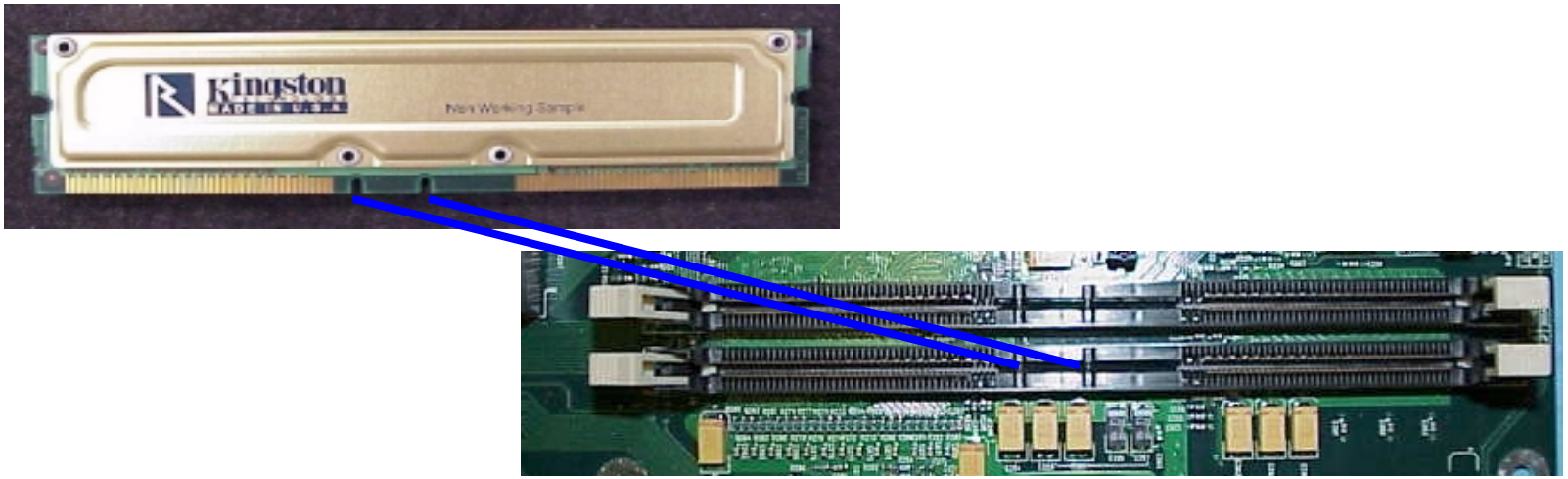
Manufacturing with RDRAM Memory Technology: System Integrating

Avoiding Manufacturing Induced Damaged

- Ensure correct orientation of the module. (The connector edge of the module has a notch in the center and one off-center. These should align with the notches in the RIMMmodule connector.) This is an important first step because often it is not noticed that orientation is incorrect until applying force. This can result in module or connector damage.



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Manufacturing with RDRAM Memory Technology - System Integrating

Avoiding Manufacturing Induced Damaged

- Before applying force, place the module in the connector making sure that it is properly aligned and at a right angle or 90 degrees to the Motherboard.

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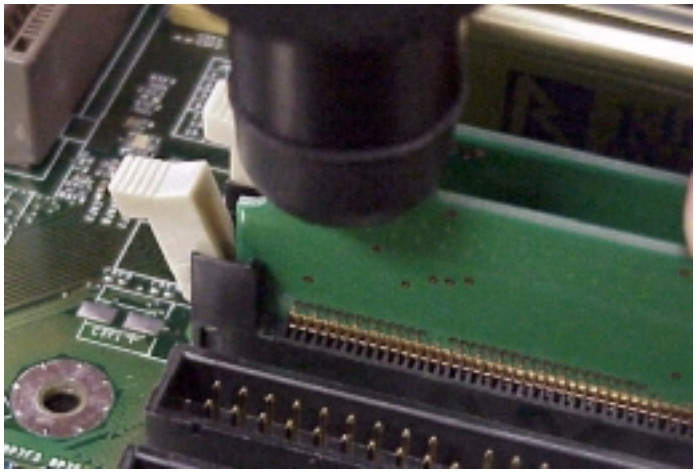
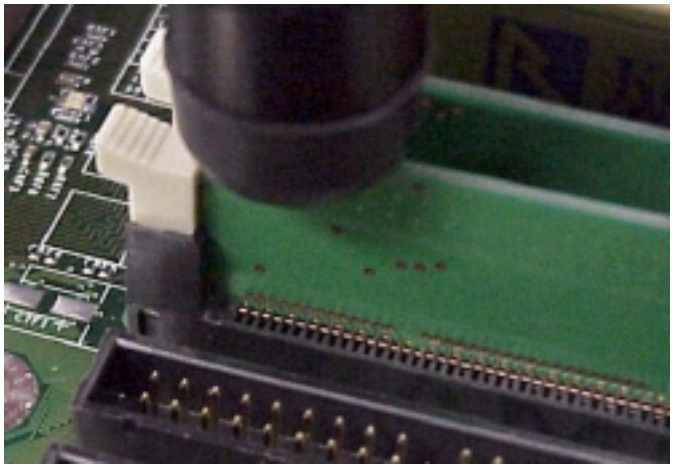
Manufacturing with RDRAM Memory Technology- System Integrating

Avoiding Manufacturing Induced Damaged

- Once aligned in the correct orientation apply even force straight down at each end of the module. This can be simultaneously applied at both end, or applied at one end and then the other.
- For manufacturing, the recommendation is installing each RIMM/CRIMM sequentially.





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Manufacturing with RDRAM Memory Technology- System Integrating

Avoiding Manufacturing Induced Damaged

- The recommended insertion of RIMM module in the motherboard is prior to the motherboard installed in the chassis. During RIMM module insertion, extensive board flex could take place if anchored in a chassis. Potential board damage could result from the board flex.

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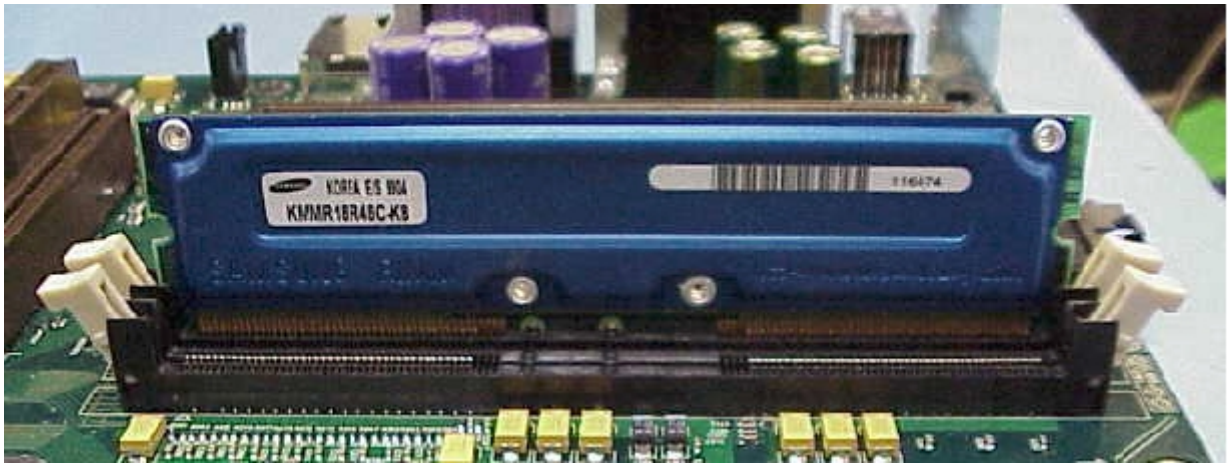
Using a RIMM module Insertion Tool



Proper alignment and orientation is critical to avoid damaging the RIMM module connector. Orient the module vertical to the motherboard to avoid damage. Possible damage can result if the angle of the RIMM module insertion is not correct.

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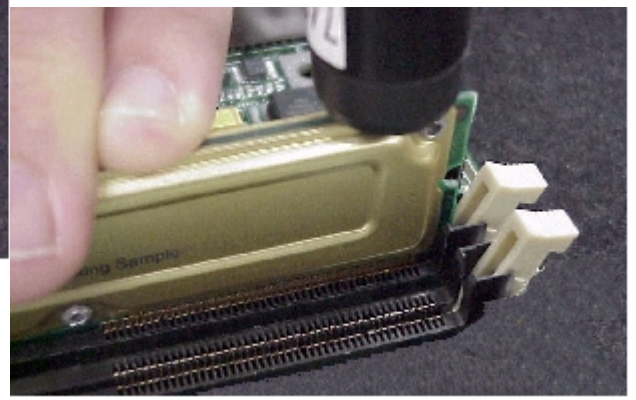
Using a RIMM Insertion Tool



The insertion tool can then be used to apply the insertion force at one end and then the other.

IMPORTANT: Orient the module vertically straight, rest the RIMM Insertion tool on the top of the RIMM or CRIMM and apply the force vertically straight downward.

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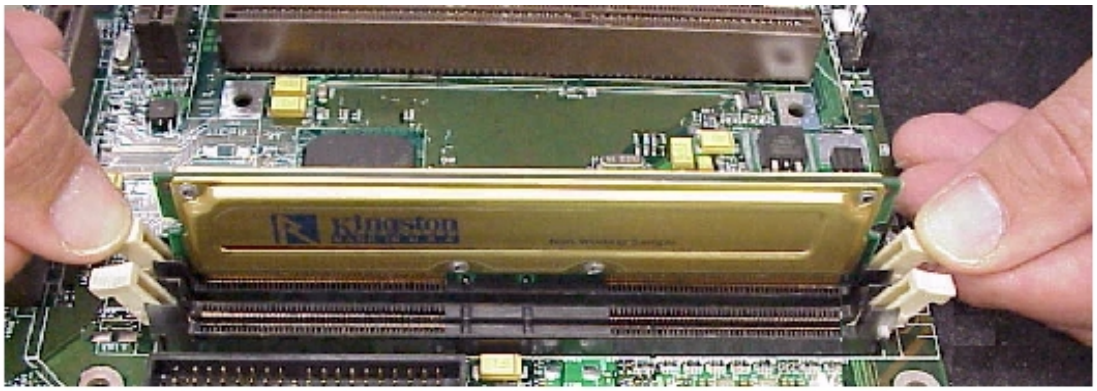
RIMM / Continuity RIMM Module Extraction



When removing the module, the end tabs are pressed straight downward with smooth even force. Pushing too hard or at an angle can cause connector damage.

Reference Information

- Thermal Solutions
  - Intel® 820 Chipset Application Note #1 - Thermal Design Considerations.
  - Intel® 840 Chipset Application Note #1 - Thermal Design Considerations.
    - » Contact your local field sales representative for copies of these documents
- RIMM Module Design
  - http://www.rimm.com
- Chipset Surface Mount Reference Information
  - http://developer.intel.com/design/quality/component/

Manufacturing with RDRAM Memory Technology

- Impedance Considerations

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Manufacturing with RDRAM Memory Technology

- Impedance
  - Direct RDRAM Channel requires impedance control
  - Impedance Specification is 28 Ohm +/- 10%
  - All Aspects of the system design are critical
    - » Follow Stack-up guidelines in the 820 and 840 Chipset design guides
- High Volume Manufacturing Considerations
  - 100% PCB impedance testing highly recommended for early production including:
    - » Motherboard
    - » RIMM
    - » CRIMM
  - Lot to Lot checks (sampling)
    - » Once stability of materials and process has been established
    - » Customers have established meeting their PCB DPM Goals

Manufacturing with RDRAM Memory Technology

- Impedance Control (Continued)
  - Recommendation is that OEMs and PCB Vendors should correlate their impedance measurements.
  - Recommend QA validation in place for incoming piece parts
    - » Statistical process control and sampling methodology recommended.
  - Board Design changes (customer reference or design changes) means board should be re-margined and qualified to ensure impedance control
    - » Contact your local Field Representative for margining methodologies.

Reference Information

- Direct RDRAM Reference Information
  - http://developer.intel.com/design/chipsets/memory/rdram/index.htm
    - » Validation Information
    - » RIMM Design Information
    - » Application Notes (impedance measurements, etc..)
    - » Specifications
- Intel® 820® and Intel® 840 Chipset Design Guides
  - http://developer.intel.com/design/chipsets/designex/
- Intel® 820® and Intel® 840 Chipset Data Sheets
  - http://developer.intel.com/design/chipsets/datashts/

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Manufacturing with RDRAM Memory Technology

- Manufacturing Debug Message
  - Methodology to Debug Failures

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Manufacturing Debug Message

System Integration

Exchanging good components out of failing systems is expensive in time, money, and labor and detracts from work on genuine failures. Helpful tips to avoid exchanging good motherboards can be found on Intel developer website at:

http://developer.intel.com/design/quality/mb/testtips.htm.

Some additional considerations with RDRAM product

- Ensure RIMM/Continuity RIMM Modules are Rev 1.0 or greater
- Ensure RIMM Configuration is supported by the motherboard application.
- Ensure proper RIMM or Continuity RIMM Module insertion and extraction recommendations are followed.
- Retest system using gold (known good) RIMM/ Continuity RIMM Modules

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Reducing Manufacturing Induced Damage

Intel has also identified general guidelines to help reduce manufacturing induced damage when manufacturing systems with Intel motherboards. More information can be found at.

http://developer.intel.com/design/quality/mb/index.htm